Boulder Creek Restoration Project

Forest Carbon Cycling and Storage Report

Prepared by:

Peter N. Zimmerman
Doug Nishek

for:

Bonners Ferry Ranger District
Idaho Panhandle National Forests

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Introduction

This report describes the evidence and rationales why, in this case, we believe additional analysis of this proposal's effects on carbon storage potential are not warranted. Nevertheless, as we recognize this is a public issue and in deference to those who commented, a qualitative analysis of this project's effects on carbon cycling and storage is provided.

Overview of Issues Addressed – Carbon cycling and storage

Public comments during scoping for the Boulder Creek Restoration Project (BCRP) asked that the FS "analyze, disclose, and consider the full range of scientific information on carbon storage, vegetation management, and wildfire."

The importance of carbon storage capacity of the world's forests is tied to their role globally in removing atmospheric carbon that is contributing to ongoing global warming. As discussed further below, meaningful and relevant conclusions on the effects of a relatively minor land management action such as this on global greenhouse gas emissions or global climate change is neither possible nor warranted in this case. Nevertheless, we recognize that global research indicates the world's climate is warming and that most of the observed 20th century increase in global average temperatures is very likely due to increased human-caused greenhouse gas emissions.

Forests cycle carbon. They are in a continual flux, both emitting carbon into the atmosphere and removing it (sequestration) through photosynthesis. The proposed actions being considered here may alter the rates and timing of that flux within the individually affected forest stands. These changes would be localized and infinitesimal in relation to the role the world's forests play in ameliorating climate change and indistinguishable from the affects of not taking the action. Nevertheless, in response and deference to those who commented, effects of the proposal on carbon cycling and storage are discussed below. Regional, continental, and global factors related to forest's influence on global climate change are also briefly discussed to provide context for understanding the nature of these local effects.

Overview of Issues Addressed – Efficacy of the Proposed Action in light of climate change

Public comments during scoping for the BCRP state that "Climate change science suggests that logging for sequestration of carbon, logging to reduce wild fire, and other manipulation of forest stands does not offer benefits to climate. Rather, increases in carbon emissions from soil disturbance and drying out of forest floors are the result. Managers of national forest lands can best address climate change through minimizing development of forest stands, especially stands that have not been previously logged, by allowing natural processes to function. Furthermore, any supposedly carbon sequestration from logging are usually more than offset by carbon release from ground disturbing activities and from the burning of fossil fuels to accomplish the timber sale, even when couched in the language of restoration."

We disagree with the conclusion reached in this comment for several reasons.

This proposal has several desired outcomes. The effectiveness of achieving those outcomes is presented throughout the EA and underlying analysis (keeping in mind that NEPA requires an agency to take a hard look at the consequences of its actions on the environment, not the other way around).

The interdisciplinary team carefully considered the existing conditions and trends within the area, as well as risks, in designing this proposal to achieve those outcomes. Global climatic warming is not something that is about to happen. It has been ongoing for many decades and the trend is expected to continue into the distant future, continuing to increase risks to our nation's forests (Dale, et al. 2001; Barton 2002; Breashears and Allen 2002; Westerling and Bryant 2008; Running 2006; Littell, et al. 2009; Boisvenue and Running 2010). The existing project area conditions and trends are an expression of the local climate (which may or may not parallel ongoing regional, continental, or global trends) as it has interacted with the other local natural and anthropomorphic influences. As such, the ongoing effects of climate change were considered in developing the proposal.

This proposal by necessity addresses site specific forest health, fish and wildlife habitat, and hazardous fuels conditions, trends, and risks that exist within the project area today. Nevertheless, those proposed actions are consistent with adaptation actions and strategies recommended for managing forests in light of climate change (Millar, et al. 2007; Joyce, et al. 2008; Ryan, et al. 2008a).

Regulatory Direction

There are no applicable legal or regulatory requirements or established thresholds concerning management of forest carbon or greenhouse gas emissions.

NEPA requires that agencies consider significant effects of proposed actions on the human environment in our decisions. The purpose of an environmental assessment is, in part, to determine whether there may be significant effects that warrant the preparation of an environmental impact statement (40 CFR 1508.9).

Guidance on Consideration of Climate Change in Project Related NEPA

Forest Service

The Forest Service has prepared agency guidance on "Climate Change Considerations in Project Level NEPA Analysis" (http://www.fs.fed.us/emc/nepa/climate_change/index.htm). This document focuses on the dual aspects of climate change 1) the effect of a proposed project on climate change through greenhouse gas emissions, and 2) the effect of climate change on a proposed project. The guidance stresses considerations in Pre-NEPA analyses, including the purpose and need and proposed action, scoping, alternative development, effects analysis, and decision documents. *The focus of the guidance is to incorporate climate change into project NEPA that is relevant for the project decision*. The Forest Service will revise this guidance as scientific understanding improves, climate change management experience is gained, and national policies are revised.

In most cases, the National Forest or Grassland is the most appropriate scale for analyzing GHG emissions, biogenic carbon, and their effects. Analysis at a smaller scale can result in inaccurate results because the carbon balance of an individual stand fluctuates cyclically over time between carbon emitter and carbon sink, depending on when natural or human disturbances have occurred to affect its development.

The 9th Circuit Court of Appeals recently agreed with that reasoning, finding that a project of similar scope as that proposed here did not warrant detailed analysis of the projects potential impacts on climate change (Hapner v. Tidwell, No. 09-35896 (9th Cir. 2010)).

Other Contextual Considerations

Other factors also indicate that, in this case, further analysis is not necessary or warranted.

The top three anthropogenic (human-caused) contributors to greenhouse gas emissions (from 1970-2004) are: fossil fuel combustion, deforestation, and agriculture (IPCC 2007, p. 36). Land use change, primarily the conversion of forests to other land uses (deforestation) is the second leading source of human-caused greenhouse gas emissions globally (Denman et al. 2007, p. 512). Loss of tropical forests of South America, Africa, and Southeast Asia is the largest source of land-use change emissions (Denman et al. 2007, pg. 518; Houghton 2005).

Unlike other forest regions that are a net source of carbon to the atmosphere, U.S. forests are a strong net carbon sink, absorbing more carbon than they emit (Houghton 2003; US EPA 2010, p. 7-14; Heath et al. 2011). For the period 2000 to 2008, U.S. forests sequestered (removed from the atmosphere, net) approximately 481.1 teragrams (Tg) of carbon dioxide per year, with harvested wood products sequestering an additional 101 Tg per year (Heath et al. 2011)[1]. Our National Forests accounted for approximately 30 percent of that net annual sequestration. National Forests contribute approximately 3 Tg carbon dioxide to the total stored in harvested wood products compared to about 92 Tg from harvest on private lands. Within the U.S., land use conversion from forest to other uses (primarily for development or agriculture) are identified as the primary human activities exerting negative pressure on the carbon sink that currently exists in this country's forests (McKinley et al. 2011; Ryan et al. 2010; Conant et al. 2007).

This proposal does not fall within any of these primary contributors of global greenhouse gas emissions nor is it similar to the primary human activities exerting negative pressure on the carbon sink that currently exists in U.S. forests. The affected forests will remain forests, not converted to other land uses, and long-term forest services and benefits will be maintained.

Affected Environment

Existing Condition

Forests are in continual flux, emitting carbon into the atmosphere, removing carbon from the atmosphere, and storing carbon as biomass (sequestration). Over the long-term, through one or more cycles of disturbance and regrowth (assuming the forest regenerates after the disturbance), net carbon storage is often zero because re-growth of trees recovers the carbon lost in the disturbance and decomposition of vegetation killed by the disturbance (McKinley et al. 2011; Ryan et al. 2010; Kashian et al. 2006).

The project area can be characterized as a patchwork of stands ranging from sapling size trees to mature sawtimber in a landscape dominated by mature lodgepole pine, Douglas-fir and larch. Most of these stands are congested with too many trees, resulting in stands that are stressed for water and nutrients and consequentially are more susceptible to drought, insects, disease, and fire. At this stage of their development, these stands are estimated to be net carbon sinks. That is, they

[1] 1 teragram (Tg) = approximately 2.2 billion pounds

are likely sequestering carbon faster than they are releasing it to the atmosphere. The strength of that sink has likely been weakened in some stands due to recent and predicted tree mortality from mountain pine beetles in lodgepole pine.

Environmental Consequences

Alternative 1 – No Action

Direct and Indirect Effects

There would be no direct human-induced emissions of carbon into the atmosphere under the No Action alternative. Forest stands would likely continue as carbon sinks until the next disturbance event (fire, wind, insect infestation, etc.) occurs. When the next forest stand replacing disturbance event (high tree mortality) occurs, the affected areas would convert to a carbon source condition (emitting more carbon than is being sequestered). This state would continue for up to a decade or more until the rate of forest regrowth, assuming trees regenerate, meets and exceeds the rate of decomposition of the killed trees. As stands continue to develop, the strength of the carbon sink would increase (typically peaking at an intermediate age and then gradually declining, but remain positive) (Pregitzer and Euskirchen 2004). Carbon stocks would continue to accumulate, although at a declining rate, until again impacted by subsequent disturbance.

For at least the short term, on-site carbon stocks would remain higher under the No Action alternative then under the Proposed Action. Nevertheless, caution is advised against interpreting carbon inventory maintenance or gains from deferred or foregone timber harvest in any specific forest or stand as affecting atmospheric concentrations of greenhouse gases. This only holds true if harvest does not occur elsewhere in the world to supply the same world demand for timber (Gan and McCarl 2007; Murray 2008; Wear and Murray 2004). The result can be a net carbon impact if the timber is replaced in the marketplace with higher carbon source products such as steel or concrete or is harvested in a manner that does not result in prompt reforestation (McKinley et al. 2011; Ryan et al. 2010; Harmon 2009).

As discussed elsewhere, the risk of some high mortality disturbance events is greater under the no action alternative. The long-term ability of these forests to persist as a net carbon sink is uncertain (Galik and Jackson 2009). Drought stress, forest fires, insect outbreaks and other disturbances may substantially reduce existing carbon stock (Galik and Jackson 2009). Climate change threatens to amplify risks to forest carbon stocks by increasing the frequency, size, and severity of these disturbances (Dale, et al. 2001; Barton 2002; Breashears and Allen 2002; Westerling and Bryant 2008; Running 2006; Littell, et al. 2009; Boisvenue and Running 2010). Recent research indicates that these risks may be particularly acute for forests of the Northern Rockies (Boisvenue and Running 2010). Increases in the severity of disturbances, combined with projected climatic changes, may limit post-disturbance forest regeneration, shift forests to non-forested vegetation, and possibly convert large areas from an existing carbon sink to a carbon source (Barton 2002; Savage and Mast 2005; Allen 2007; Strom and Fulé 2007; Kurz et al. 2008a; Kurz et al. 2008b; Galik and Jackson 2009). Leaving areas of forest densely stocked, as in the no action alternative, maintains an elevated risk of carbon loss due to disturbance. Thinning, prescribed fire, and other management actions are often suggested as climate change “adaptation actions” because they may increase forest resilience to these multiple stresses, and thus increase the likelihood of sustaining forest carbon benefits in the long-term (Millar et al. 2007; Joyce et al.

2008; Ryan et al. 2008b). The no action alternative foregoes such climate change adaptation actions.

Alternatives 2 and 3 – The Action Alternatives

Direct and Indirect Effects

In the short-term, the action alternatives would remove and release some carbon currently stored within treatment area biomass through harvest of live and dead trees and other fuel reduction activities, including prescribed burning. A portion of the carbon removed would remain stored for a period of time in wood products (US EPA 2010; Depro et al. 2008). Additionally, motorized equipment used during any of the proposed activities will emit greenhouse gasses.

For at least the short-term, on site carbon stocks would be lower under the action alternatives than under No Action. The amount of carbon stocks retained would be proportional to the number of acres and amount of vegetation treated by alternative. Actions such as those proposed here may, in some cases, increase long term carbon storage (Finkral and Evans 2008; North et al. 2009; Mitchell, et al. 2009) but current research in this field shows highly variable and situational results (McKinley et al. 2011; Mitchell et al. 2009; Reinhardt and Holsinger 2010; Ryan et al. 2010).

The proposed stand vegetation and fuel reduction treatments would reduce existing carbon stocks and temporarily reduce net carbon sequestration rates within treated stands, in some areas possibly enough that for the short term the stands would emit more carbon than they are sequestering. These stands would remain a source of carbon to the atmosphere (or weakened sink) until carbon uptake by new and remaining trees again exceeds the emissions from decomposing dead organic material. As stands continue to develop, the strength of the carbon sink would increase then gradually decline, but remain positive (Pregitzer and Euskirchen 2004). Carbon stocks would continue to accumulate, although at a declining rate, until impacted by future disturbances.

As discussed elsewhere, the risk of some high mortality disturbance events is greater under the no action alternative. To the extent the proposed actions reduce the risk or delay the event of future stand replacing disturbance events, potential emissions from those events are equally reduced or forestalled.

Sustaining forest productivity and other multiple-use goods and services requires that land managers balance multiple objectives. The long-term ability of forests to sequester carbon depends in part on their resilience to multiple stresses, including increasing probability of drought stress, high severity fires, and large scale insect outbreaks associated with projected climate change. Management actions, such as those proposed with this project that maintains the vigor and long-term productivity of forests and reduce the likelihood of high severity fires and insect outbreaks can maintain the capacity of the forest to sequester carbon in the long-term. Thus, even though some management actions may in the near-term reduce total carbon stored below current levels, in the long-term they maintain the overall capacity of these stands to sequester carbon, while also contributing other multiple-use goods and services (Reinhardt and Holsinger 2010).

Cumulative Effects

Neither the No Action alternative or the Proposed Action would have a discernable impact on atmospheric concentrations of greenhouse gases or global warming, considering the limited changes in both rate and timing of carbon flux predicted within these few affected forest acres and the global scale of the atmospheric greenhouse gas pool and the multitude of natural events and human activities globally contributing to that pool.

Although not a statutorily defined purpose of National Forest System management, forests do provide a valuable ecosystem service by removing carbon from the atmosphere and storing it in biomass (Galik and Jackson 2009). As stated above, U.S. forests are a strong net carbon sink, absorbing more carbon than they emit (Houghton 2003; US EPA 2010, p. 7-14; Heath et al. 2011). For the period 2000 to 2008, U.S. forests sequestered (removed from the atmosphere, net) approximately 481.1 teragrams of carbon dioxide per year, with harvested wood products sequestering an additional 101 teragrams per year (Heath, et al. 2011). Our National Forests accounted for approximately 30 percent of that net annual sequestration. National Forests contribute approximately 3 Tg carbon dioxide to the total stored in harvested wood products compared to about 92 Tg from harvest on private lands. The BCRP would affect only a tiny percentage of the forest carbon stocks of the Idaho Panhandle National Forests, and an infinitesimal amount of the total forest carbon stocks of the United States.

Within the U.S., land use conversions from forest to other uses (primarily for development or agriculture) are identified as the primary human activities exerting negative pressure on the carbon sink that currently exists in this country's forests (McKinley et al. 2011; Ryan et al. 2010; Conant et al. 2007). The affected forest lands in this proposal would remain forests, not converted to other land uses, and long-term forest services and benefits would be maintained.

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Review of literature provided in comments

Depro, Brooks M., Brian C. Murray, Ralph J. Alig, and Alyssa Shanks. 2008. Public land, timber harvests, and climate mitigation: quantifying carbon sequestration potential on U.S. public timberlands. Forest Ecology and Management 255: 1122-1134.
Depro et al. uses simulation modeling to evaluate the forest carbon implications of three broad scenarios of management of all U.S. public forests. It is national in scope, and models three broad scenarios. Its relevancy is primarily at the national policy consideration level, and as discussed below has limitations. Their analysis concludes that a “no timber harvest” scenario results in more carbon stored in public forests over coming decades nationwide than a “business-as-usual” scenario of 15 to 20 million cubic feet of timber harvest volume per decade. This conclusion, and their model, is based on the assumption that fire, insects, disease, and other natural mortality would remove timber volume on 140,000 acres annually on all public forests in the contiguous 48 States, a small fraction of actual recent forest disturbance rates (Westerling, et al. 2006). The paper does not specifically addresses the forest types, current conditions, or natural disturbance regimes of the project area. Most significantly, the paper grossly underestimates or ignores the role of fire, forest insects, and forest pathogens in the forest carbon cycle. Throughout the Northern Rockies, and including the Flathead National Forest, these natural disturbance processes have much greater impacts on carbon stocks and rates of carbon sequestration by forests than timber harvesting and fuels management. Attempting to maximize forest carbon storage near the theoretical “potential” in these disturbance prone forests may be counterproductive because increasing tree density often increases drought stress, vulnerability to mortality from bark beetles, and probability of crown fire (Reinhart 2010). Indeed, in some forest types, increasing tree density may lead to the loss of old trees and substantial loss of carbon stocks (Fellows and Goulden 2008). More fundamentally, the paper does not account for what is commonly referred to as leakage; where carbon inventory maintenance or gains in one location results in equal losses elsewhere due to global market forces (Gan and McCarl 2007; Murray 2008; Wear and Murray 2004). The result can be a net carbon impact if, for example, timber from public lands is replaced in the marketplace with higher carbon source products such as steel or concrete or is harvested elsewhere in a manner that does not result in prompt reforestation (Ryan, et al. 2010; Harmon 2009).
Harmon, Mark E, William K. Ferrell, and Jerry F. Franklin. 1990. Effects of carbon storage of conversion of old-growth forest to young forests. Science 247: 4943: 699-702 -and- Harmon, Mark E. 2001. Carbon sequestration in forests: addressing the scale question. Journal of Forestry 99:4: 24-29.
Harmon et al. (1990) and Harmon (2001) provide general descriptions of the carbon cycle for forests in western Oregon and Washington. These papers make the point that old forests generally store more carbon than younger forests. While we agree with that fact, it is also true

that the forests of western Oregon and Washington have disturbance and succession dynamics, and thus carbon dynamics that differ substantially from the Flathead National Forest.
Harmon, Mark E. and Barbara Marks. 2002. Effects of silvicultural practices on carbon stores in Douglas-fir – western hemlock forests in the Pacific Northwest, USA: results from a simulation model. Canadian Journal of Forest Research 32: 863-877.
Harmon and Marks (2002) focus primarily on the aspects of dynamics of Douglas-fir/western hemlock forests in western Oregon and Washington. This study uses a computer model to examine the carbon implications of several silvicultural practices. This study found that: forests protected from fire stored the greatest amount of landscape-level carbon, carbon stores increased with rotation length (assuming no natural disturbance), and carbon stores decreased as the fraction of trees harvested and detritus removed increased. The authors concluded that in the case of high wood products utilization and severe slash-burning, increasing rotation length from 40 to 120 years increased landscape-level carbon stores more than 2.5 fold. The authors concluded that partial timber harvest with minimum use of slash-burning may increase carbon stores to two-fold compared to silvicultural practices that authors describe as traditional for the study area. In addition, based on their model simulations, the authors concluded that if carbon storage was the only land management consideration conversion to an old-growth dominated landscape would be the best option because the model suggests such a landscape would store close to 90 percent of the potential maximum. Again, we note that these conclusions for forests of western Oregon and Washington are unlikely to apply to forests of western Montana, which have very different, and generally more frequent, natural disturbance regimes.
Homann, Peter S., Mark Harmon, Suzanne Remillard, and Erica A.H. Smithwick. 2005. What the soil reveals: potential total ecosystem C stores of the Pacific Northwest region, USA. Forest Ecology and Management 220: 270-283.
Homann, et al. (2005) measured total ecosystem organic carbon in 35 old growth forest stands in Oregon and Washington. All but 4 stands were in relatively warm and wet forests in coastal forests or on the west-side of the Cascade Mountains. The authors extrapolated the carbon measurements from these stands to estimate the theoretical potential carbon stores for the entire region (western Oregon and Washington). Comparing the results of this extrapolation to estimates of existing carbon stocks from other studies (using different methods), the authors concluded that current carbon storage in western Oregon and Washington is less than half the theoretical potential. The authors acknowledged that converting to a “theoretical landscape without catastrophic natural or human disturbance” is unrealistic. This paper, and a very similar paper by many of the same authors (Smithwick, et al. 2002), explain that natural disturbance regimes and other factors will result in regional carbon sequestration capacities that may be much different from the theoretical potential reported in Homann, et al. (2005).
McKenzie, Donald, Ze’ev Gedalof, David L. Peterson, and Philip Mote. 2004. Climatic change, wildfire, and conservation. Conservation Biology 18:4: 890 -902. (5-85)

McKenzie, et al. (2004) examines various fire record and climate reconstructions to infer how fire regimes may be altered under climatic-change scenarios for the western United States. Implications for conservation are then explored.

The paper's projections for longer fire seasons resulting in more and larger fires is consistent with ongoing observed trends and projections reached elsewhere in the literature (for example: Dale, et al. 2001; Barton 2002; Breashears and Allen 2002; Westerling and Bryant 2008; Running 2006; Littell, et al. 2009; Boisvenue and Running 2010) as are the implications for forests and forested habitats of the inland west.

In review, we did not find anything in the paper that, "undermines the central underlying purpose of the project," as the comment claims. Rather the actions proposed here are consistent with adaptation actions and strategies recommended for managing forests in light of climate change (Millar, et al. 2007; Joyce, et al. 2008; Ryan, et al. 2008). Although limited in scale and scope, we believe the BCRP proposal is also consistent with the McKenzie, et al. general recommendation to development management strategies that mitigate risk to ecosystems and sensitive species.